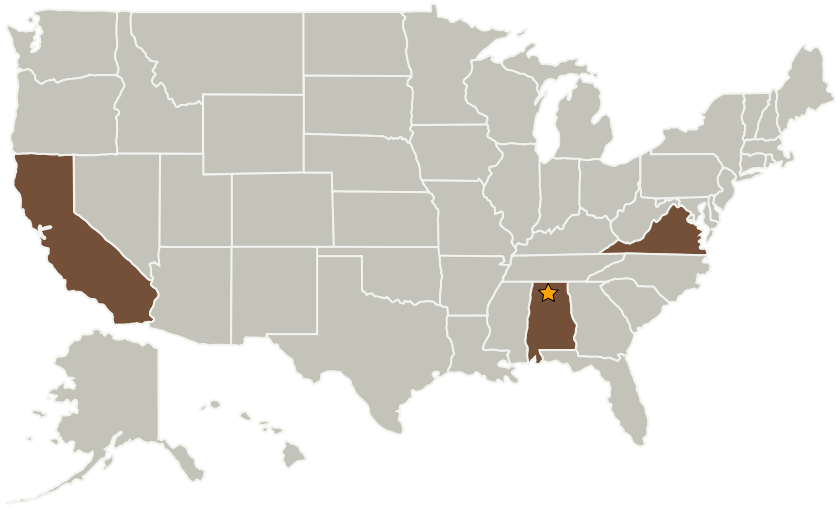
Low Erosion Ceramic Composite Liners for Improved Performance of Ablative Rocket Thrust Chambers, Phase I

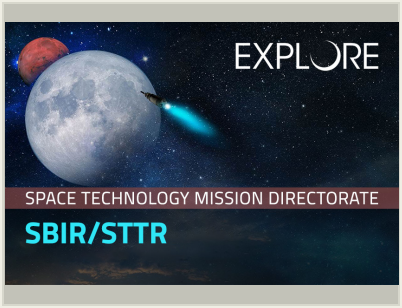
Completed Technology Project (2008 - 2009)

Project Introduction

Advanced liquid rocket propulsion systems must achieve longer burn times without performance degradation to allow the lowest cost per kilogram access to space. Ablative thrust chambers have an extensive heritage and are the low cost approach to fabricating rocket thrust chambers. However, composite ablative chambers suffer from erosion that typically limits performance of the engine in terms of burn time and efficiency/performance of the combustion. In the last decade, there has been significant interest in utilizing fiber-reinforced ceramic composites such as carbon fiber-reinforced silicon carbide (C/SiC) composites. Such composites have demonstrated a low erosion rate in bi-propellant liquid rocket thrust chambers at temperatures approaching 4000F. However insertion of these materials have been limited by complexities associated with required system redesign to accommodate a radiatively-cooled chamber, attachment methods, and addressing chamber permeability issues. By incorporating a ceramic composite liner within an ablative thrust chamber in critical areas that are subjected to the highest temperatures, a low erosion, high performance chamber is obtained that eliminates costs and complexities that have limited the insertion of ceramic composite thrust chambers. The Phase I effort will produce a ceramic composite lined ablative thrust chamber, identify the degree of film cooling required and conduct a static hot fire test evaluation of the material to demonstrate the perfromance benefit of a CMC liner within an ablative thrust chamber.

Primary U.S. Work Locations and Key Partners





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Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Marshall Space Flight Center (MSFC)

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Small Business Innovation Research/Small Business Tech Transfer

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Organizations Performing Work	Role	Type	Location
★Marshall Space Flight Center(MSFC)	Lead Organization	NASA Center	Huntsville, Alabama
Hyper-Therm High-Temperature Composites	Supporting Organization	Industry	Huntington Beach, California

Primary U.S. Work Locations	
Alabama	California
Virginia	

Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Principal Investigator:

Robert Shinavski

Technology Areas

Primary:

- TX01 Propulsion Systems
  - TX01.1 Chemical Space Propulsion
    - TX01.1.3 Cryogenic